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LYSO based precision timing calorimeters

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In this report we outline the study of the development of calorimeter detectors using bright scintillating crystals. We discuss how timing information with a precision of a few tens of pico seconds and below can significantly improve the reconstruction of the physics events under challenging high pileup conditions to be faced at the High-Luminosity LHC or a future hadron collider. The particular challenge in measuring the time of arrival of a high energy photon lies in the stochastic component of the distance of initial conversion and the size of the electromagnetic shower. We present studies and measurements from test beams for calorimeter based timing measurements to explore the ultimate timing precision achievable for high energy photons of 10 GeV and above. We focus on techniques to measure the timing with a high precision in association with the energy of the photon. We present test-beam studies and results on the timing performance and characterization of the time resolution of LYSO-based calorimeters. We demonstrate time resolution of 30 ps is achievable for a particular design.

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